Some Aspects of Adult Assembly and Sexual Behavior of *Rosalia funebris* Motschulsky under Artificial Conditions

(Coleoptera: Cerambycidae)

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During the first week of July 1970, we were informed of the presence of large numbers of *Rosalia funebris* in the business district of Santa Rosa, California. The beetles were aggregating on the outside walls of a bank building (Fig. 1), and had elicited considerable interest and curiosity from residents. The local newspaper contained an illustrated article referring to the incident.

Since few accounts of such assemblages have been published (Essig, 1943, reported on a collection of 150 specimens of *Rosalia* from a commercial paint shop in Ukiah, California), we proceeded to Santa Rosa on 7 July 1970 in order to make first hand observations. Upon our arrival at 11:05 a.m. (PST), numerous adults were visible on the walls of the bank building. Specimens were collected from the outside walls, bushes, and sidewalks around the structure. They were sluggish and not easily disturbed, the males resting much higher than the females.

By 12:05 p.m. the sun was shining brightly on the front of the building and at that time only three males were evident, the others having moved into shade. At 12:30 p.m. the male nearest to the corner of the wall moved around it into the shade; the other two followed at 12:44 p.m. and 1:14 p.m., respectively; the individual closer to the edge moving first.

According to bank officials, the beetles had been coming to the building over a period of 10 days to two weeks, reaching a peak during a hot spell at the end of the previous week (1–3 July) when daytime temperatures had risen to 101°–102° F. On 4 July, the temperature began to fall off and by 6 July, noticeably fewer specimens were evident about the building. On 7 July, the first individual seen in flight, a male, arrived at 12:35 p.m., alighting on the northside shady wall. Five additional specimens (4 males, 1 female), appeared during the next 22 minutes, all settling on shady portions of the building.

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Although the level of activity as reported to us had decreased by 7 July, we collected 32 accessible males and 11 females from the building and immediate vicinity and estimated that 30–40 individuals still remained on the walls out of reach, in spite of the fact that Dr. Anderson had taken 75 specimens, 48 males and 27 females, the previous day. According to bank personnel, the beetles had occurred in such large numbers during the peak period that they were a definite nuisance.

While in Santa Rosa, we were also informed of reports of large numbers of *Rosalia* on the grounds of a prefabrication building plant 4.5 miles north of town. At this site we found the beetles concentrated in the paint shop and painting areas, including the assembly area for prefabricated products (Fig. 1). Both sexes were attracted to sites where a flat white latex undercoating was applied to the products. In the several hundred foot long assembly building, the beetles inside were found primarily within 100 feet of the large open end of the structure. Numerous individuals were also present in and about the paint storage sheds nearby (Fig. 1). One empty five gallon paint can contained six females trapped in the paint residue and another three adults (Fig. 1). Most specimens taken in the paint shed were either recently dead or very sluggish to the point of being immobilized. However, the latter individuals became active immediately when captured and placed in plastic bags. Thirty-six specimens (21 males, 15 females) were collected in the plant. All of these were on or near dry paint and none were present on the wet, freshly applied coats on the walls of the finished structures.

According to the foreman and several of the workers, beetles had been present during each of the past five years, individuals arriving after the first hot spell of summer.

In view of the report by Essig (1943) on the attractiveness of paint to *Rosalia*, and our observations at the assembly plant, an inquiry at the bank building in Santa Rosa revealed that it had been painted recently. The high temperatures in early July had presumably caused volitilization of certain ketones in the paints, suggesting that these were involved in the attraction of *Rosalia*. According to Essig, the Ukiah specimens were also attracted during a hot spell. Further indication that high temperatures might be a factor in activating attractive elements in the paint was the fact that in the laboratory at room temperatures, fresh samples of the same paint used on the building in Santa Rosa elicited no response from the beetles. However, the adults were not long lived enough to permit us to determine whether or not the age of the paint after application might have also been involved. Another

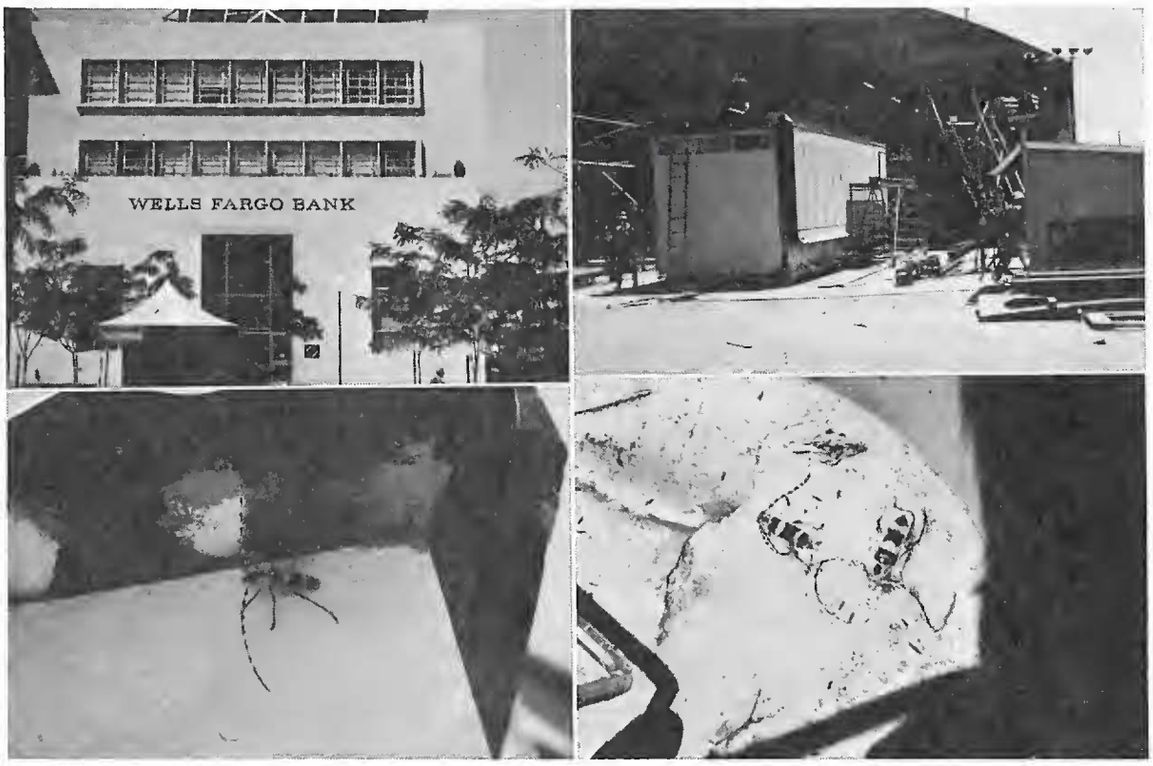

FIG. 1. *Upper left.*—site of adult *Rosalia funebris* Motschulsky assembly in Santa Rosa, California. *Upper right.*—area of *Rosalia* assembly north of Santa Rosa. *Lower left.*—male *Rosalia* on paint shed. *Lower right.*—adult *Rosalia* entrapped in residue in paint bucket.

consideration may be that high temperatures trigger a gregarious response in the beetles.

Since very little information on the habits of *Rosalia funebris* has been published, all of the live adults collected at Santa Rosa were brought into the laboratory for observations. Reported hosts for this species are *Alnus* spp., *Fraxinus* spp., *Quercus* spp., *Salix* spp., and *Umbellularia californica* (Hook. & Arn.) Nutt. (Linsley, 1964). Although *Umbellularia* has not been confirmed as a primary host since the species was designated as the California Laurel Borer by Essig (1926), the adults were introduced into a large rearing cage containing four 10 inch diameter logs of *U. californica.* These logs had been attacked previously by *Leptalia macilenta* LeConte, lucanids (*Platycerus*), and other deadwood species and were fairly dry at this time. In addition most of the bark had been removed in order to study *Leptalia*, in particular. However, *Rosalia* were attracted to the logs and mating and subsequent oviposition were readily observable.

MATING BEHAVIOR.—This activity was studied with individual couples placed in cardboard cartons with transparent tops, as well as those individuals (about 20 males and 10 females) which were introduced into the large cage containing the four laurel logs.

The same basic mating pattern occurred in all of the numerous cases observed, both in the confinement of the small containers and the relative freedom of movement possible within the cage. After the initial contact, the male mounted the female from the side (Fig. 2). He quickly assumed a parallel position while palpating her pronotum with his palpi and mandibles (Fig. 2). The front legs grasped the female behind the humeri, while the middle legs were extended laterally and the hind pair posteriorly but not in contact with her body. During mating the antennae of the male were gradually arched outward and posteriorly and those of the female were arched forward. Immediately upon assuming this position on the female, the male curved the abdomen forward with the apex forming a scoop-like right angle and attempted to insert the phallus. If joining was successful, the male moved back slightly and gently extracted the female genitalia while lowering the head and touching the pronotum with his mouthparts. The pulling and bowing motions persist for from 30 to 60 seconds and just prior to disjoining, these actions become very rapid. Usually the bowing occurred every four seconds with faint stridulations audible during the upward motion. The sounds are produced by the movement of the pronotum over the mesonotal plate. In most cases after disjoining, the female would explore the substrate with her ovipositor while the male remained in amplexus with his body at an angle to hers with his mouthparts contacting her elytra.

The various couples exhibited very little variation in these actions, the principle differences involving the length of time from initial contact to complete separation. One pair uncoupled after 8 minutes and remained motionless. One minute later the female moved her antennae and ran her front legs over the scape. About 20 minutes later the male appeared immobile but tightened his grip when the female moved her antennae. A little later the male moved back assuming a 45° angle while the female extruded her ovipositor. In several cases the male grasped the antennae of the female during the rapid terminal copulatory motions and appeared to bite strongly.

Competition with other males appeared to be a factor influencing the length of time an individual male remained in contact with a female. Although the high individual density and confined conditions of the cage provided an artificial situation, at least some of the antagonistic behavior exhibited probably occurs in nature. Fighting between males was common, both between individuals and between single males and mating males. The latter situation developed when single males attempted

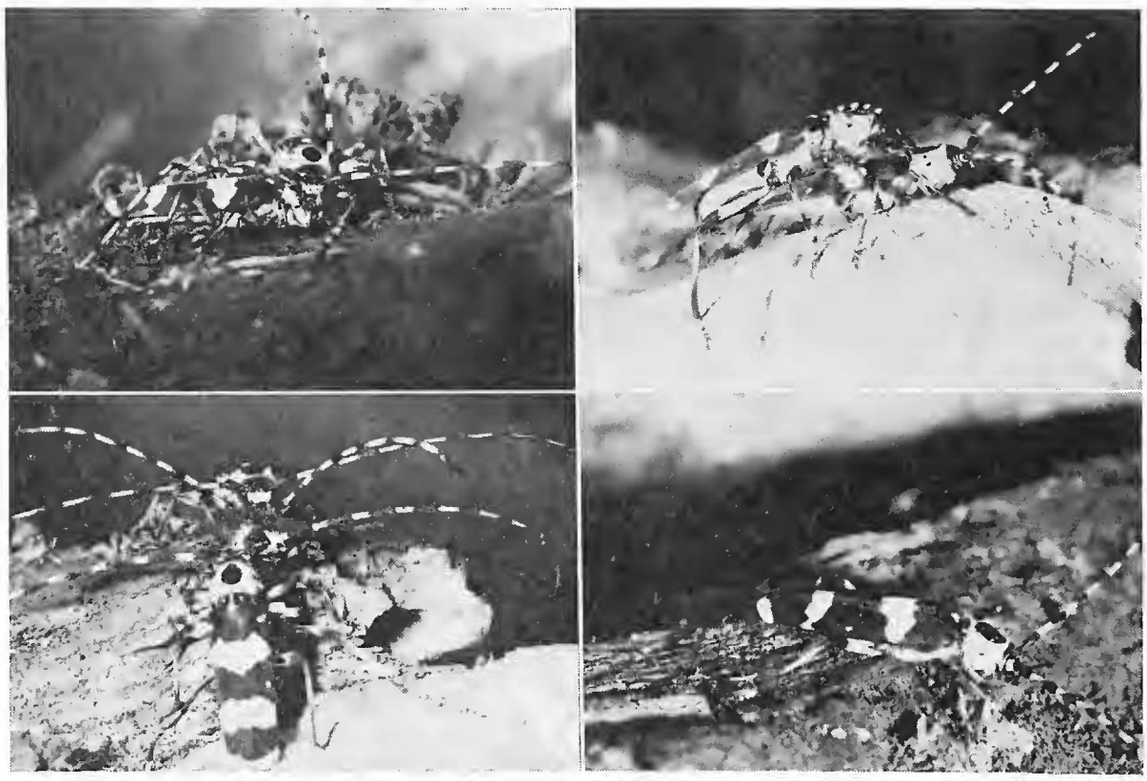

FIG. 2. *Upper left.*—male *Rosalia* mounting female. *Upper right.*—typical mating position of *Rosalia*. *Lower left.*—male intruding upon a mating pair. *Lower right.*—female seeking oviposition niches.

to dislodge the male in a mating pair. When thus interrupted, mating males leave the female and engage the intruder. Usually they run directly at the intruder making contact with the head and mandibles. While the two were entangled, each attempted to bite the appendages of the other. Usually one or the other became dislodged from the log and ran off while the victor engaged the female. Size was important in determining the outcome of these encounters and the larger males easily dislodged small opponents. A small male could not successfully mate with a large female since his genitalia could not reach hers while he was engaged in palpating the pronotum.

In one instance, a male came upon a mating pair from the front. He hooked his front legs over the antennae of the female and remained face to face with the mounted male (Fig. 2). When the female attempted to move forward, he pushed her backward and when she moved backward, he grasped her antennal scape with his mandibles and held her immobile. The trio remained in this position until the mating male dismounted and the female broke loose and attempted to oviposit.

In most cases, copulation between the same individuals occurred a number of times. After each joining, the male remained with the female while she oviposited. When an egg was laid, the male usually attempted

to couple again immediately, with the entire behavioral sequence being repeated.

In conclusion, the sexual behavior of *Rosalia funebris* may be summarized briefly for comparison with a number of species studied by Michelsen (1966a, 1966b). It involves licking during amplexus, tapping, sound production, and pulling the ovipositor during copulation. This suggests a relatively high degree of evolution of sexual behavior from the "pure licking" of the more primitive forms of Cerambycidae.

OVIPOSITION.—After copulation, the females search for oviposition niches. While searching she extrudes the ovipositor and holds her antennae forward and extended somewhat laterally with the apices bent to touch the substrate surface (Fig. 2). When a suitable niche or crack was found, the ovipositor was inserted, the antennae were drawn backward and extended laterally and a single egg was deposited with gentle pulsations of the body. In most cases, the ovipositor remained in the substrate for a minute or two. On the *Umbellularia* logs, the niches most commonly selected were split openings at the ends of the logs. However, eggs were also laid in artificial crevices made by the insertion of a knife into the wood.

Rosalia eggs are elongate (3+ mm long, .75 mm diameter), whitish, and translucent. The end attached to the substrate is narrower with the surface covered by a slightly sticky gelatinous coating.

Unfortunately, the condition of the logs was not conducive to the hatching of eggs and larval development. The reasons for this are not clear but probably involved the nature and moisture content of the wood. In nature the hosts are generally present along water courses and washes where a relatively high moisture content is maintained by the dead wood. It is also possible that *Umbellularia* is not a suitable host for larval development. Further studies of host requirements for this species are obviously needed.

LITERATURE CITED

ESSIG, E. O. 1926. Insects of Western North America. ix + 1035 pp. 766 figs. Macmillan, N. Y.

1943. The California-laurel borer, *Rosalia funebris* Mots. Pan-Pac. Entomol., 19: 91–92.

LINSLEY, E. G. 1964. The Cerambycidae of North America. Part V. Taxonomy and classification of the subfamily Cerambycinae, tribes Callichromini through Ancylocerini. Univ. Calif. Publ. Entomol., 22: 1–197.

MICHELSEN, A. 1966a. The sexual behavior of longhorned beetles. Entomol. Medd., 34: 329–355.

1966b. On the evaluation of tactile stimulatory actions in longhorned beetles. Z. Tierpsychol., 23: 257–266.